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Docket No. 21182-7067

**Certificate of Mailing/Transmission (37 C.F.R. § 1.8(a)):**

[ ] Pursuant to 37 C.F.R. § 1.8, I hereby certify that this paper and all enclosures are being deposited with the United States Postal Service as first class mail on the date indicated below in an envelope addressed to the Assistant Commissioner for Patents, Washington D.C. 20231.

Dated: July 30, 2001

Name of Person Certifying: Caroline Pearl

Printed Name: CAROLINE PEARL



EXD  
2127102

#4

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant:	MARDER, et al.	Assignee:	California Institute of Technology
Filing Date:	Herewith	Examiner:	Not Yet Assigned
Serial No.:	Not Yet Assigned	Group Art Unit:	Not Yet Assigned
Title:	TWO-PHOTON OR HIGHER-ORDER ABSORBING OPTICAL MATERIALS AND METHODS OF USE		

Assistant Commissioner for Patents  
Washington, D.C. 20231

**INFORMATION DISCLOSURE STATEMENT**

Sir:

In accordance with 37 C.F.R. § 1.56, the references listed on the attached Form PTO-1449 are being brought to the attention of the Examiner for consideration in connection with the examination of the above-identified patent application.

**I. Timing of the Information Disclosure Statement:**

This Information Disclosure Statement is filed:

- ☒ With the new patent application submitted herewith (37 C.F.R. § 1.97(a)).
- ☐ Within three months after the filing date of the application or within three months after the date of entry of the national stage of a PCT application as set forth in 37 C.F.R. § 1.491.
- ☐ Before the mailing date of a first Office action on the merits. In the event, however, that an Office Action has crossed in the mail with this Information Disclosure Statement, the Commissioner is hereby authorized to charge Deposit Account No. [ ] for any fees required pursuant to 37 C.F.R. §§ 1.17(p) or 1.17(i)(1).

This Information Disclosure Statement is filed:

- ☐ After the first Office Action and more than three months after the application's filing date; or PCT national stage date of entry filing but, as far as is known to the undersigned, prior to the mailing date of either a final rejection or a notice of allowance, whichever occurs first, and the Commissioner is hereby authorized to charge Deposit Account No.[ ] for the fee (\$180) set forth in 37 C.F.R. § 1.17(p) and any additional required fees.

This Information Disclosure Statement is filed:

- ☐ After the mailing date of either a final rejection or a notice of allowance, whichever occurred first, and is accompanied by the fee (\$180.00) set forth in 37 C.F.R. § 1.17(i)(1) and a certification as specified in 37 C.F.R. § 1.97(e), as checked below. This document is to be considered as a petition requesting consideration of the Information Disclosure Statement.

The undersigned certifies that:

- ☐ Each item of information contained in the Information Disclosure Statement was cited in a communication mailed from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this information disclosure statement.
- ☒ No item of information contained in this information disclosure statement was cited in a communication mailed from a foreign patent office in a counterpart foreign application or, to the knowledge of the undersigned after making reasonable inquiry, was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing of this Information Disclosure Statement.

**II. Copies of the Cited Items:**

- ☐ Copies of all of the items listed on the attached Form PTO-1449 are enclosed.
- ☐ Copies of only the following items listed on the attached Form PTO-1449 are enclosed: \_\_\_\_\_.
- ☒ Copies of those items which are marked with an asterisk (\*) in the attached Form PTO-1449 are not supplied because they were previously cited by or submitted to the Patent Office in a prior Application No. 08/965,945, filed November 7, 1997 and relied upon in this application for an earlier filing date under 35 U.S.C § 120.  
See 37 C.F.R. § 1.98(d).

- ☐ Copies of those items which are marked with an asterisk (\*\*) in the attached Form PTO-1449 were cited in a foreign examination report in a related case. A copy of the search report and the cited references not already of record in this application are attached hereto.

**III. Concise Explanation of Relevance:**

- ☒ A concise explanation of relevance of the items listed on Form PTO-1449 is not given.
- ☐ A concise explanation of relevance of the items listed on Form PTO-1449 is in the form of an English language copy of a Search Report from a foreign patent office, issued in a counterpart application, which refers to the relevant portions of the references (copy attached).

**IV. Conclusion:**

Citation of the above documents shall not be construed as:

1. an admission that the documents are necessarily prior art with respect to the instant invention;
2. a representation that a search has been made, other than as described above; or
3. an admission that the information cited herein is, or is considered to be, material to patentability as defined in § 1.56(b).

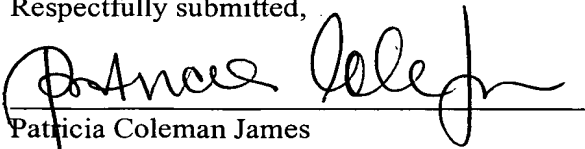
It is respectfully requested that the Examiner indicate consideration of the cited references by returning a copy of the attached form PTO 1449 with initials or other appropriate marks.

The Commissioner is hereby authorized to charge Deposit Account No. 50-1193 Docket No. 21182-7067 for any additional fees required in connection with the filing of this Information Disclosure Statement.

DATE: 30 July 01

Respectfully submitted,

By

  
Patricia Coleman James  
Registration No.: 37,155

McCutchen, Doyle, Brown & Enersen, LLP  
Three Embarcadero Center, Suite 1800  
San Francisco, California 94111  
Telephone: (415) 393-2000  
Telefax: (415) 393-2286

**LIST OF PATENTS AND PUBLICATIONS FOR  
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(Use several sheets if necessary)

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21182-7067

SERIAL NO.

Not yet assigned

INVENTOR

MARDER, et al.

FILING DATE

Herewith

GROUP ART UNIT

Not yet assigned

1c5978 U.S. PTD

09/918874



## REFERENCE DESIGNATION

## U.S. PATENT DOCUMENTS

EXAM'R INITIAL		DOCUMENT NUMBER	DATE	NAME	Class	Subclass	Filing Date If Appropriate
*	A1	4,041,476	08/09/77	Swainson, et al.	340	173	07/23/71
*	A2	4,078,229	03/07/78	Swainson, et al.	340	173	01/27/75
*	A3	4,238,840	12/09/80	Swainson, et al.	365	119	04/22/77
*	A4	4,288,861	09/08/81	Swainson, et al.	365	127	01/22/79
*	A5	4,333,165	06/01/82	Swainson, et al.	365	120	12/01/77
*	A6	4,466,080	08/14/84	Swainson, et al.	365	106	04/15/81
*	A7	4,471,470	09/11/84	Swainson, et al.	365	127	02/22/82
*	A8	5,034,613	07/23/91	Denk, et al.	250	458.1	11/14/89
*	A9	5,268,862	12/07/93	Rentzepis	365	151	04/25/89
*	A10	5,523,573	06/04/96	Hanninen, et al.	250	459	12/28/94
*	A11	4,014,871	03/29/77	Kormány, et al.	260	240 C	08/06/75
*	A12	4,165,434	09/21/79	Schäfer, et al.	544	197	06/01/77
*	A13	4,271,395	06/02/81	Brinkman, et al.	331	94.5 L	01/03/78
*	A14	5,009,815	04/23/91	Wakita, et al.	252	582	02/09/90
*	A15	5,086,239	02/04/92	Wang	359	328	02/22/90
*	A16	5,451,494	09/19/95	Diehl, et al.	430	522	07/22/94
*	A17	5,670,090	09/23/97	Marder, et al.	252	582	06/01/95
*	A18	5,795,729	08/18/98	Lee	435	24	02/05/96

## FOREIGN PATENT DOCUMENTS

EXAM'R INITIAL		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	Subclass	TRANSLAT'N	
							yes	no
*	B1	2187734	7/90	Japan	252	582	X	

## OTHER ART (Include Author, Title, Date, Pertinent Pages, etc.)

*	C1	Anderson, et al., "Two-photon absorptivities of the all <i>trans</i> $\alpha$ , $\omega$ -diphenylpolyenes from stilene to diphenyloctatetraene via three wave mixing," <i>J. Chem. Phys.</i> 70 (9), pp. 4310-15 (1979).
*	C2	Beljonne, et al., "Two-photon absorption and third-harmonic generation of di-alkyl-amino-nitro-stilbene (DANS): A joint experimental and theoretical study," <i>J. Chem. Phys.</i> 103 (18), pp. 7834-43 (1995).
*	C3	Bhawalkar, et al., "Efficient, two-photon pumped green upconverted cavity lasing in a new dye," <i>Opt. Comm.</i> 124, pp. 33-37 (1996).
*	C4	Birge, "An Introduction to Two-Photon Spectroscopy," <i>Spectroscopy of Biological Molecules: Theory and Applications - Chemistry, Physics, Biology, and Medicine</i> , No. 39, pp. 457-71 (1983).
*	C5	Bimbaum, et al., "Location of a $A_2$ state in bithiophene," <i>J. Chem. Phys.</i> , 96 (4), pp. 2492-95 (1992).
*	C6	Bimbaum, et al., "Low lying singlet states of $\alpha$ , $\omega$ -dithienylpolyenes: $\alpha$ , $\omega$ -dithienylbutadiene, $\alpha$ , $\omega$ -dithienylhexatriene, and $\alpha$ , $\omega$ -dithienyloctatetraene," <i>J. Chem. Phys.</i> , 94 (3), pp. 1684-91 (1991).
*	C7	Brede, et al., "Photo- and Radiation-induced Chemical Generation and Reactions of Styrene Radical Cations in Polar and Non-polar Solvents," <i>J. Chem. Soc. Perkin Trans. 2</i> , pp. 23-32 (1995).
*	C8	Carre, et al., "Biphotonic process for recording holograms with continuous-wave lasers in the near infrared," <i>Optics Letters</i> , 12 (9), pp. 646-47 (1987).
*	C9	Castevens, Martin K., et al., "A New Class of Materials for Optical Power Limiting", in Nonlinear Optical liquids and power limiters; Proceedings of the Meeting, San Diego, CA, July 30-31, 1997 (A98-22080 05-74), Bellingham, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings, Vol. 3146), 1997, p. 152-159.
*	C10	Cha, et al., "Two photon absorption of di-alkyl-amino-nitro-stilbene side chain polymer, <i>Appl. Phys. Lett.</i> 65 (21), pp. 2648-50 (1994).
*	C11	Couris, et al., "Concentration and wavelength dependence of the effective third-order susceptibility and optical limiting of $C_{60}$ in toluene solution," <i>J. Phys. B: At. Mol. Opt. Phys.</i> 28, pp. 4537-54 (1995).

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**INVENTOR**  
MARDER, et al.

**FILING DATE**  
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*	C12	Denk, et al., "Anatomical and functional imaging of neurons using 2-photon laser scanning microscopy," <i>J. Neuroscience Methods</i> 54, pp. 151-62 (1994).
*	C13	Denk, et al., "Two-Photon Laser Scanning Fluorescence Microscopy," <i>Science</i> 248, pp. 73-76 (1990).
*	C14	Desai, et al., "Laser-Induced Polymerization within Carbon Disulfide Clusters," <i>J. Phys. Chem.</i> , 99 (6), pp. 1786-91 (1995).
*	C15	El-Shall, et al., "Comparative Polymerization in the Gas Phase and in Clusters. 2. Electron Impact and Multiphoton-Induced Reactions in Isobutene and Benzene/Isobutene Clusters," <i>J. Am. Chem. Soc.</i> , 117 (29), pp. 7744-52 (1995).
*	C16	Fuke, et al., "Two-Photon Absorption spectrum of Trans-Stilbene, Trans-Cis Photoisomerization via Upper $^1A_g$ State," <i>Chem. Phys. Lett.</i> 74 (3), pp. 546-548 (1980).
*	C17	Goodman, et al., "Two-Photon Spectra of Aromatic Molecules," <i>Acc. Chem. Res.</i> 17, pp. 250-57 (1984).
*	C18	He, et al., "Nonlinear optical properties of a new chromophore," <i>J. Opt. Soc. Am B</i> 14 (5), pp. 1079-87 (1997).
*	C19	He, et al., "Studies of two-photon pumped frequency-upconverted lasing properties of a new dye material," <i>J. Appl. Phys.</i> 81 (6), pp. 2529-37 (1997).
*	C20	He, et al., "Two-photon absorption and optical-limiting properties of novel organic compounds," <i>Opt. Lett.</i> 20 (18), pp. 435-37 (1995).
*	C21	He, et al., "Two-photon absorption based optical limiting and stabilization in organic molecule-doped solid materials," <i>Opt. Comm.</i> , 117, pp. 133-36 (1995).
*	C22	He, et al., "Upconversion dye-doped polymer fiber laser," <i>Appl. Phys. Lett.</i> 68 (25), pp. 3549-51 (1996).
*	C23	Hunter, et al., "Potentials of two-photon based 3-D optical memories for high performance computing," <i>Applied Optics</i> 29 (14), pp. 2058-66 (1990).
*	C24	Itoh, et al., "Dual Fluorescence of Diphenylpolyenes," <i>J. Phys. Chem.</i> , 91 (7), pp. 1760-64 (1987).
*	C25	Itoh, et al., "Fluorescence quantum yields of $\alpha$ , $\omega$ -diphenylpolyenes," <i>Spectrochimica Acta</i> 50A (13), pp. 2261-63 (1994).
*	C26	Jones, et al., "Direct observation of the $2^1A_g$ electronic state of carotenoid molecules by consecutive two-photon absorption spectroscopy," <i>J. Photochem. Photobiol. A: Chem.</i> 68, pp. 59-75 (1992).
*	C27	Kennedy, et al., "p-Bis( $\alpha$ -methylstyryl)benzene as a Power-Squared Sensor for Two-Photon Absorption Measurements between 537 and 694 nm," <i>Anal. Chem.</i> 58 (13), pp. 2643-47 (1986).
*	C28	Kim, et al., "Synthesis of Electroluminescent Polymer containing charge Transport and Emissive Chromophores on Polymer Skeleton," <i>Chemistry Letters</i> , pp. 587-88 (1995).
*	C29	Kohler, et al., "Fluorescence from the $1^1B_u$ State of Diphenylhexatriene: Inversion of the $1^1B_u$ and $2^1A_g$ Levels In $CS_2$ ," <i>J. Phys. Chem.</i> , 92 (18), pp. 5120-22 (1988).
*	C30	Kohler, et al., "Saturation kinetics of the $S_0$ to $S_2$ optical transition in isolated diphenylhexatriene," <i>J. Chem. Phys.</i> , 82 (7), pp. 2939-41 (1985).
*	C31	Kumar, et al., "Optical nonlinearity in a mode-locking dye: optical limiting and four wave mixing," <i>Chemical Physics Letters</i> 245, pp. 287-91 (1995).
*	C32	Lakowicz, et al., "Two Photon-Induced Fluorescence Intensity and Anisotropy Decays of Diphenylhexatriene in Solvents and Lipid Bilayers," <i>Journal of Fluorescence</i> 2 (4), pp. 247-58 (1992).
*	C33	Lin, et al., "Dual Fluorescence of $\rho, \rho'$ -Disubstituted 1,6-Diphenyl-1,3,5-hexatrienes: Evidence of a Twisted Intramolecular Charge Transfer State," <i>J. Phys. Chem.</i> 93 (1), pp. 39-43 (1989).
*	C34	Luo, et al., "One- and Two-Photon Absorption Spectra of Short Conjugated Polyenes," <i>J. Phys. Chem.</i> 98 (32), pp. 7782-89 (1994).
*	C35	Maiti, et al., "Measuring Serotonin Distribution in Live Cells with Three-Photon Excitation," <i>Science</i> 275, pp. 530-32.
*	C36	Maruo, et al., "Three-dimensional microfabrication with two-photon-absorbed photopolymerization," <i>Opt. Lett.</i> 22 (2), pp. 132-34 (1997).
*	C37	McEwan, et al., "Picosecond-induced Nonlinear Absorption in Liquid Crystal Media," <i>J. Nonlinear Opt. Phys. and Mater.</i> 4 (1), pp. 245-60 (1995).
*	C38	Mertz, et al., "Single-molecule detection by two-photon-excited fluorescence," <i>Optics Letters</i> 20 (24), pp. 2532-34 (1995).
*	C39	Narang, et al., "Characterization of a New Solvent-Sensitive Two-Photon-Induced Fluorescent (Aminostyryl)pyridinium Salt Dye," <i>J. Phys. Chem.</i> 100 (11), pp. 4521-25 (1996).
*	C40	Parma, et al., "Two-Photon Absorption of 7-Hydroxycoumarin," <i>Chem. Phys. Lett.</i> 54 (3), pp. 541-43 (1978).
*	C41	Parthenopoulos, et al., "Three-Dimensional Optical Storage Memory," <i>Science</i> 245, pp. 843-45 (1989).
*	C42	Plakhotnik, et al., "Nonlinear Spectroscopy on a Single Quantum System: Two-Photon Absorption of a Single Molecule," <i>Science</i> 271, pp. 1703-05 (1996).
*	C43	Prasad, et al., "Multiphoton Resonant Nonlinear Optical Processes in Organic Molecules," ACS Symposium, Chapter 13, pp. 225-36 (1996).

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*	C44	Puccetti, <i>et al.</i> , "Chain-Length Dependence of the Third-Order Polarizability of Disubstituted Polyenes. Effects of End Groups and Conjugation Length," <i>J. Phys. Chem.</i> , 97 (37), pp. 9385-91 (1993).
*	C45	Rava, <i>et al.</i> , "Regularities in the two-photon spectra of polysubstituted benzenes," <i>J. Chem. Phys.</i> , 77 (10), pp. 4912-19 (1982).
*	C46	Rice, <i>et al.</i> , "Two-Photon, Thermal Lensing Spectroscopy of Monosubstituted Benzenes in the ${}^1B_{2u}({}^1L_u) \leftarrow {}^1A_{1g}({}^1A)$ and ${}^1B_{1u}({}^1L_u) \leftarrow {}^1A_{1g}({}^1A)$ Transition Regions", <i>J. Phys. Chem.</i> 90, pp. 6793-6800 (1986).
*	C47	Roux, <i>et al.</i> , "Two-photon-absorption-induced luminescence in organic waveguide couplers," <i>J. Opt. Soc. Am. B</i> , 12 (3), pp. 428-33 (1995).
*	C48	Said, <i>et al.</i> , "Third- and fifth-order optical nonlinearities in organic materials," <i>Chem. Phys. Lett.</i> 228, pp. 646-50 (1994).
*	C49	Stachelek, <i>et al.</i> , "Detection and assignment of the 'phantom' photochemical singlet of <i>trans</i> -stilbene by two-photon excitation," <i>J. Chem. Phys.</i> , 66 (10), pp. 4540-43 (1977).
*	C50	Strickler, <i>et al.</i> , "3-D Optical Data Storage by Two-Photon Excitation," <i>Adv. Mater.</i> 5 (6), pp. 479-81 (1993).
*	C51	Strickler, <i>et al.</i> , "Three-dimensional optical data storage in refractive media by two-photon point excitation," <i>Optics Letters</i> 16 (22), pp. 1780-82 (1991).
*	C52	Strickler, <i>et al.</i> , "Two-photon excitation in laser scanning fluorescence microscopy," <i>SPIE</i> 1398, pp. 107-18 (1990).
*	C53	Sutherland, <i>et al.</i> , "Two-photon absorption and second hyperpolarizability measurements in diphenylbutadiene by degenerate four-wave mixing," <i>J. Chem. Phys.</i> 98 (4), pp. 2593-2603 (1993).
*	C54	Tackx, <i>et al.</i> , "Distinction of two-photon absorption from other nonlinear loss mechanisms by phase-conjugate interferometry," <i>Appl. Phys. Lett.</i> 65 (3), pp. 280-82 (1994).
*	C55	Williams, <i>et al.</i> , "Two-photon molecular excitation provides intrinsic 3-dimensional resolution for laser-based microscopy and microphotochemistry," <i>The FASEB Journal</i> 8, pp. 804-13 (1994).
*	C56	Wong, <i>et al.</i> , "Measurements of $\chi^{(3)}(\omega; \omega, -\omega, \omega)$ in conducting polymers at $\lambda=620$ nm," <i>Synthetic Metals</i> 49-50, pp. 13-20 (1992).
*	C57	Xu, <i>et al.</i> , "Determination of absolute two-photon excitation cross sections by <i>in situ</i> second-order autocorrelation," <i>Optics Letters</i> 20 (23), pp. 2372-74 (1995).
*	C58	Xu, <i>et al.</i> , "Measurement of two-photon excitation cross sections of molecular fluorophores with data from 690 to 1050 nm," <i>J. Opt. Soc. Am. B</i> 13 (3), pp. 481-91 (1996).
*	C59	Zhao, <i>et al.</i> , "Influence of two-photon absorption on third-order nonlinear optical processes as studied by degenerate four-wave mixing: The study of soluble didecyloxy substituted polyphenyls," <i>J. Chem. Phys.</i> 95 (6), pp. 3991-4001 (1991).
*	C60	Zhao, <i>et al.</i> , "Newly Synthesized Dyes and Their Polymer/Glass Composites for One-and Two-Photon Pumped Solid-State Cavity Lasing," <i>Chem. Mater.</i> 7 (10), pp. 1979-83 (1995).

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